(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 297 611 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **88110576.1**

(51) Int. Cl.4: **D06N 7/00**

(22) Date of filing: **01.07.88**

(30) Priority: **01.07.87 US 68393**

(43) Date of publication of application:
04.01.89 Bulletin 89/01

(84) Designated Contracting States:
AT BE DE FR GB IT NL SE

(71) Applicant: **HERCULES INCORPORATED**
Hercules Plaza
Wilmington Delaware 19894(US)

(72) Inventor: **Goss, Raymond Walter**
20 South Townview Lane-Woodmere
Newark Delaware 19711(US)

(74) Representative: **Lederer, Franz, Dr. et al**
Van der Werth, Lederer & Riederer
Patentanwälte Lucile-Grahn-Strasse 22
D-8000 München 80(DE)

(54) Fabric lamination of unitary backed hot melt constructed carpet tile.

(57) A warp resistant tile and method for preparation thereof in which a primary facing layer is secured to a backing laminate that comprises an intermediate layer of substantial weight, bulk, and strength and a thin flexible base layer.

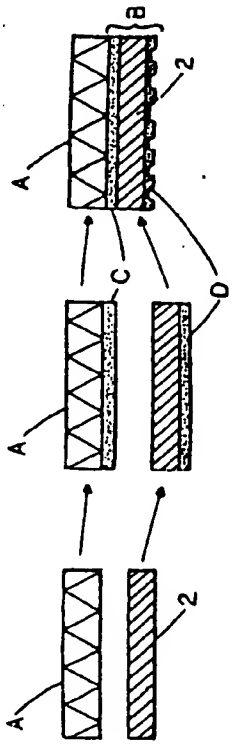

FIG. 3

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FABRIC LAMINATION OF UNITARY BACKED HOT MELT CONSTRUCTED CARPET TILE

This invention relates to a warp-resistant carpet tile in which a functional or primary facing layer is secured by an adhesive layer to a flexible backing layer.

Carpet tile offers a number of economic advantages and conveniences over traditional "broadloom" carpeting. This is particularly true with regard to ease of repair or replacement of specific areas that are subject to excessive wear from heavy traffic patterns.

Carpet tiles, however, also have some recognized disadvantages involving production and quality control problems. These often involve relatively high unit costs and unacceptable variations in quality.

For example, a relatively heavy extrusion backing and relatively thick adhesive layer between the backing and the facing are usually relied on to provide adequate weight, flexibility and structural strength. However, production and market considerations limit the choice of facing and backing combinations, and the number of environmentally-acceptable adhesives that can be successfully used to bind carpet facing and backing layers under high speed production conditions is also limited. The most desirable for high speed production conditions are hot melt adhesives.

When conventional hot melt adhesives are used, it is necessary to pre-stretch the primary facing and the backing layers to smooth out wrinkles and obtain an even surface for the application of the adhesive and subsequent mating of the layers. The stretching step causes a number of serious problems, since the primary carpet facing layers and other layers are unlikely to have the same elastic properties as the conventional heavy tile backing, and few adhesive compositions, particularly hot melt adhesives, can assure consistent adhesive shear strength or absence of stress between the respective layers, and avoid damage to the adhesive layers or warpage of the finished tile caused by such stress.

Also, while the conventional heavy extruded PVC tile backing or base layer will provide a substantial amount of lateral strength, such a backing layer often lacks sufficient flexibility to compensate for surface irregularities of a floor or base surface. This can result in cracking and slippage of the tile after installation.

U.S. Patent 4,522,857 of Higgins relates to tufted or bonded carpet tile in which the functional or primary facing layer ("carpet base (12)") consists of loop or cut pile of synthetic yarns embedded in a primary backing material (22), and a latex precoat (24) or hot melt adhesive (36) with fiber glass reinforcement (38) bonded to a thick (.1"-1") high-density polyurethane foam layer (28) and a thinner carrier backing (26) of woven polypropylene. On the external or bottom side of the tile, the foam has a tough integral skin surface (30), which is apparently of the type associated with heat curing techniques known to the blow molding art, and therefore is not comparable in its durability with either a conventional PVC extruded-type carpet tile base layer or a thinner but durable backing or base layer of the type that could be laminated to a complementary additional layer.

In the reference, between the functional or primary facing layer and the foam layer, the middle layer consisting of a latex precoat (24) or hot melt adhesive (36), with a glass scrim (18) embedded in an adhesive layer (16) that provides some degree of dimensional stability but obviously does not supply the enough resiliency or bulk, thus necessitating the inclusion of the relatively fragile foam layer (18).

There is a need for carpet tile structure in which the conventional heavy extruded PVC tile backing or base layer is replaced by a thinner and more flexible but nevertheless durable backing layer that can be readily laminated to a middle layer by conventional high-speed roll-coating production methods using hot melt adhesives, the laminated combination of middle and backing layers providing the weight, bulk, resiliency, and dimensional stability that conventionally would be supplied by a heavier extruded PVC tile backing layer alone or the relatively fragile foam layer of U.S. Patent 4,522,857.

According to the invention, a carpet tile having a functional or primary facing layer secured by an adhesive layer to a flexible backing layer, is characterized in that the flexible backing layer is a laminate of an intermediate layer, a laminating adhesive layer and a flexible base layer, the intermediate layer contains compressible elements providing bulk and resilience sufficient to absorb normal vertical distortions of the base layer and is secured by a primary adhesive layer to the primary facing layer, and the base layer is a polyolefin film or a fabric conformable to normal irregularities found in flooring substrates. Preferably, the compressible elements in the intermediate layer contain air spaces or cells.

The carpet tile according to the invention and its manufacture are illustrated in the accompanying drawings,in which the relative dimensions of the respective components are only approximated:

Figure 1 is a schematic view of a production line that can be used for high speed preparation of the carpet tile according to the invention;

Figure 2 is a schematic view of a part of the production line of Figure 1;

Figure 3 is a partial schematic sectional view of a carpet tile according to the invention;

Figure 4 is a partial schematic sectional view of a modified form of the carpet tile of Figure 3.

With reference to Figure 3, (A) represents the primary facing layer, which comprises a woven or nonwoven fabric,such as the wool, nylon, polyester, polyolefin or similar fiber materials, or a fibrillated film conventionally used for the purpose, any of which may be in the conventional tufted or non-tufted forms. It can include supplemental reinforcing material such as fiberglass. This primary facing component (A) conventionally weighs about 678 to 1627 g/m^2 (20-48 oz/yd^2) and has virtually no cross-directional (CD) or other structural strength. It therefore provides decoration, texture and some bulk, but relatively little tile weight and virtually no dimensional stability or structural strength unless supplemented with a reinforcing material.

The primary facing layer (A) is conventionally precoated with a latex or resin anchoring composition (not shown) precoated in a conventional way by roll, spray or the like to anchor the fiber materials. Such anchoring compositions may be hydrocarbon resins such as Piccovar CB-48 (obtainable from Hercules Incorporated), or carboxylated SBR (styrenebutadiene rubber) compositions.

The intermediate layer (2), which forms part of the the flexible backing laminate (B), preferably comprises, for instance, styrofoam balls or fines, or waste pieces of nylon, encapsulated by or sandwiched between polyolefin film, or alternatively multiple layers of fibrillated films or woven or nonwoven fabrics or a layer of scrim embedded in adhesive. It can vary in thickness upwards from about 0.08 mm (3 mil), preferably from 0.64 mm (25 mil), to any thickness desired on the basis of application requirements and cost. Preferably it should weigh at least about 33.9 g/m^2 (1 oz/yd^2) e.g. 67.8 g/m^2 (2 oz/yd^2) preferably to 678 g/m^2 (20 oz/yd^2). These parameters are to be selected in light of the need to compensate to a substantial degree for vertical irregularities in floor or base surfaces covered by the tile and other well known requirements.

With reference to Figure 4, (in which each element is indicated by the same reference character as in Figure 3 with an added apostrophe), the intermediate layer may incorporate two layers (2′, 2′) bonded to each other and to the facing layer with adhesive layers (C′) to form with the flexible base layer (D′) a composite backing laminate (B′). Additional layers may be incorporated similarly into the composite backing laminate.

Such augmented base layer can conveniently vary in weight from about 1356 - 2712 g/m^2 (40 - 80 oz/yd^2) or less, provided the combined layer supplies sufficient flexibility to the tile.

With reference to Figures 3 and 4, the flexible base layer (D) or (D′) according to the invention preferably is a layer of hot melt adhesive applied conventionally or, alternatively, a combination of adhesive layers with a nonwoven or fibrillated polyolefin film layer or a sheet of fabric, that has durability, flexibility, and adhesive-holding properties when exposed to pressure and lateral stress.

Preferably the flexible base layer (D) or (D′) should weigh about 1357 to 3392 g/m^2 (40-100 oz/yd^2), and be about 0.635 mm to 2.0 mm (25-80 mil) thick. With a backing layer of this weight and thickness, the intermediate layer (2) and the primary and secondary adhesive layers (C) or (C′) and (D) and (D′) together can provide sufficient weight, bulk, resiliency and dimensional stability, as well as durability at least equivalent to that provided by the heavy backing of conventional tiles, and requires less production-time at lower cost.

Preferably, the overall weight and thickness of the backing laminate (B) or (B′) (including the primary adhesive layer (C) or (C′), the intermediate layer (2) or (2′), and the secondary adhesive layer or base (D) or (D′)), can vary at least from about 0.76 mm to 4.6 mm (30-180 mil) and weigh 4071 g/m^2 (120 oz/yd^2) or more, having in mind the requirements noted above, with the thickness of the primary adhesive layer being from about 0.51 mm to 7.6 (20-300 mil).

With further reference to Figures 3 and 4, the primary adhesive layer (C) or (C′), which bonds the intermediate layer to the primary facing layer (A) or (A′) and the secondary adhesive layer (D) or (D′) (which as indicated above, may be the base layer) are preferably environmentally acceptable hot melt adhesives and provide a substantial amount of lateral flexibility and shear resistance in the carpet tile according to the invention.

Conventional hot melt adhesives suitable for the primary and secondary adhesive layers include ethylene-vinylacetate copolymers and aliphatic and aromatic hydrocarbon resins (obtainable commercially from Hercules Incorporated under the trademarks Piccovar® CB-20, Hercotoc® AD, Piccopole®, Picco® 5000, and Picco® 6000). As a matter of convenience, the primary and secondary adhesive layers may comprise identical or similar compositions, as may be convenient.

An advantage of the carpet tile according to the invention is its avoidance of dependence upon the choice and amount of primary and secondary adhesive layers to provide the desired combination of properties, providing a broad choice of adhesives

and facing and backing combinations that are compatible with high speed production conditions.

Also according to the invention, a continuous production-line method for making a carpet tile in which a primary facing layer has its inner face bonded to a carpet backing and the resulting material is cut into tiles, is characterized in that the carpet backing includes an intermediate layer having an upper face for bonding to the primary facing layer and a lower face for bonding to a base layer, a hot-melt adhesive is continuously roller-coated onto the inner face of the primary facing layer and the primary facing layer is passed to a cooled mating roll, the carpet backing is continuously prepared by coating a hot-melt adhesive onto the lower face of the intermediate layer, and the primary facing layer and the intermediate layer are passed over the mating roll in bonding contact between the adhesive-coated face of the primary facing layer and the upper uncoated face of the intermediate layer and over a cooling table (13) prior to being cut into tiles.

The backing laminate (B) is preferably preformed in situ, with the secondary adhesive or base layer (D) wholly or partly set up before marriage with the primary facing layer. Alternatively, it may be separately prepared and introduced from a storage roll, as shown in Figure 2.

More specifically, with reference to the production line shown in Figure 1, the primary facing layer (A) is fed through a tentering frame (22) and a predetermined amount of tension is applied to minimize wrinkles and surface irregularities by passing through tension and guide rolls (3) (4) and (19) equipped with an appropriate by-pass roll arrangement (4).

The primary facing layer (A) is then passed through a primary adhesive applicator comprising an adhesive well (5) containing adhesive (C) and pick-up and application rolls (6) (7), to apply adhesive onto the inner face of facing layer (A) at a point just upstream of the locus of contact with the backing laminate (B). The latter comprises the flexible base layer (if used in addition to the secondary adhesive), which is fed from backing roll, and the intermediate layer (2), which is fed from a feed roll (9) (or a comparable box or bin, not shown) and has an upper face for bonding to the facing layer and a lower face; both the base layer and intermediate layers are prestretched by use of tension rolls (e.g. 3'). A hot-melt adhesive is applied to the lower face of the intermediate layer (2) by use of a slot die (21) fed from a feed line (24) to provide the secondary adhesive layer (D). The conventional source of the secondary adhesive (and heating means when hot-melt adhesive is used) are not shown.

Continuous embossing belt (25) contacts the hot adhesive base/intermediate layer combination at marriage roll (20), this roll having convenient temperature circumference, and speed of rotation to imprint the base and set up applied adhesive layers (B) and (C) prior to release of tension on the uncut tile.

The combined primary facing layer (A) and backing laminate (B) are then passed, in register, over cooling table (13), and the resulting uncut tile material (14) and continuous embossing belt (25) passed over tentering frame (15), separated, and the tile passed to accumulator (16) prior to cutting (not shown).

The adhesive-treated intermediate layer (2) is then passed over part of a cooled conventional mating roll (20)for the desired degree of setting of the adhesive, and the base layer (1) is introduced at this point for combination with the intermediate layer to produce the unitary backing laminate (B), which is then passed over the remainder of the mating roll with its upper uncoated face in bonding contact with the adhesive-coated face of the primary facing layer. The circumference and temperature of mating roll (20) determines the amount of cooling or set-up of secondary adhesive that occurs prior to combination with the primary facing layer.

If the secondary adhesive layer (D) is the base layer, the feed arrangement for the flexible base layer will of course be eliminated or not used, and only the adhesive layer (D) will be applied to the intermediate layer (2).

If desired, mating roll (20) can also be replaced with multiple cooling rolls to more closely approximate the functional situation in which backing laminate (B) is introduced as a unit. The combined primary facing layer (A) and backing laminate (B) are then passed over a cooling table (13), and the resulting uncut tile material (14) passed over tentering frame (15) and accumulator (16) prior to a conventional cutting step (not shown).

Figure 2 demonstrates a further modification of Figure 1, in which the backing laminate (B), (shown in the Figure as 23A), is preformed, stored, and fed as needed over roll (20A). Such arrangement, while somewhat more expensive than the process of Figure 1, substantially limits the amount of internal shear force that must be absorbed by adhesive layers or otherwise adjusted within the production line.

Claims

1. A carpet tile having a functional or primary facing layer secured by an adhesive layer to a flexible backing layer, characterized in that the flexible backing layer is a laminate of an intermedi-

ate layer, a laminating adhesive layer and a flexible base layer, the intermediate layer contains compressible elements providing bulk and resilience sufficient to absorb normal vertical distortions of the base layer and is secured by a primary adhesive layer to the primary facing layer, and the base layer is a polyolefin film or a fabric conformable to normal irregularities found in flooring substrates.

2. A carpet tile as claimed in claim 1, further characterized in that the compressible elements in the intermediate layer contain air spaces or cells.

3. A carpet tile as claimed in claim 2, further characterized in that the compressible elements in the intermediate layer are particulate styrofoam or nylon, encapsulated by or sandwiched between polyolefin film.

4. A carpet tile as claimed in claim 2, further characterized in that the compressible elements in the intermediate layer are one or more layers of fibrillated film, woven or nonwoven fabrics, or scrim embedded in adhesive.

5. A carpet tile as claimed in claim 1, 2, or 3, further characterized in that the intermediate layer is at least 0.64 mm thick and weighs at least about 678 g/m^2.

6. A carpet tile as claimed in claim 1, 2, or 3, further characterized in that the intermediate layer may incorporate at least two layers bonded together with adhesive.

7. A carpet tile as claimed in any of the preceding claims, further characterized in that the flexible base layer is a layer of hot melt adhesive or a combination of adhesive layers with a film of polyolefin.

8. A carpet tile as claimed in in claim 7, further characterized in that the flexible base layer is about 0.635 mm to 2.0 mm thick and weighs 1357 to 3392 g/m^2.

9. A carpet tile as claimed in in claim 7, further characterized in that the backing laminate is at least about 4.6 mm thick and weighs at least 4071 g/m^2.

10. A carpet tile as claimed in any of the preceding claims, further characterized in that the primary adhesive layer is from about 0.51 mm to 7.6 mm thick.

11. A carpet tile as claimed in any of the preceding claims, further characterized in that the primary adhesive layer is a hot melt adhesive.

12. A continuous production-line method for making a carpet tile in which a primary facing layer has its inner face bonded to a carpet backing and the resulting material is cut into tiles, is characterized in that the carpet backing includes an an intermediate layer having an upper face for bonding to the primary facing layer and a lower face for bonding to a base layer, a hot-melt adhesive is roller-coated onto the inner face of the primary facing layer and the primary facing layer is passed to a cooled mating roll, the carpet backing is prepared by coating a hot-melt adhesive onto the lower face of the intermediate layer, the adhesive on the lower face of the intermediate layer is passed over part of the circumference of the mating roll for partial setting of the adhesive, and the primary facing layer and the intermediate layer are passed together over the mating roll in bonding contact between the adhesive-coated face of the primary facing layer and the upper uncoated face of the intermediate layer and then over a cooling table prior to being cut into tiles.

13. A continuous production-line method for making a carpet tile as claimed in claim 11, further characterized in that a sheet of base layer material is passed onto contact with the lower coated face of the intermediate layer as it is passed over part of the circumference of the mating roll.

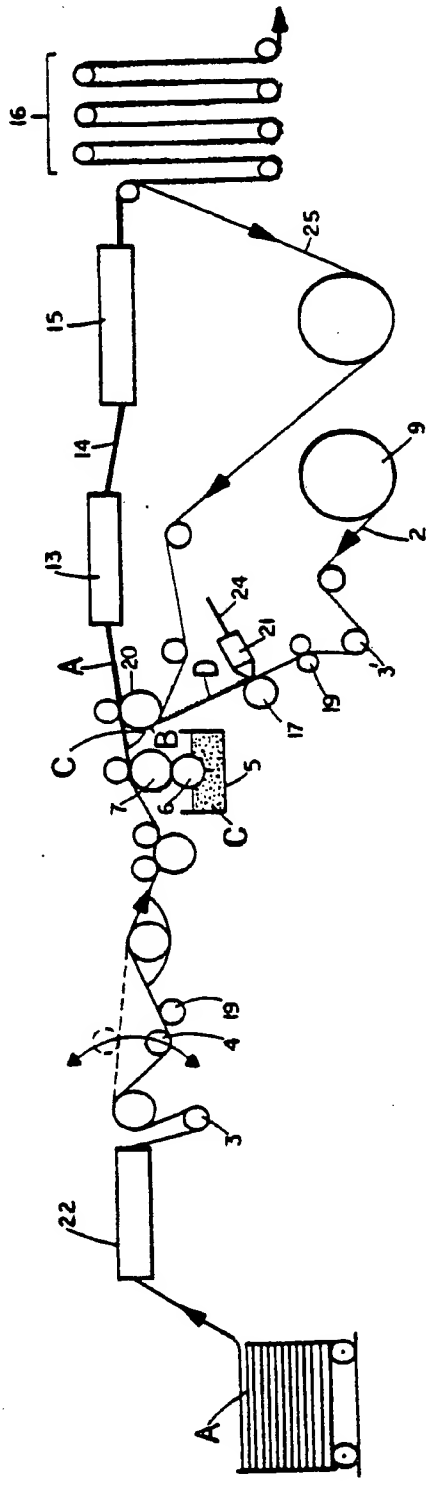

FIG. 1

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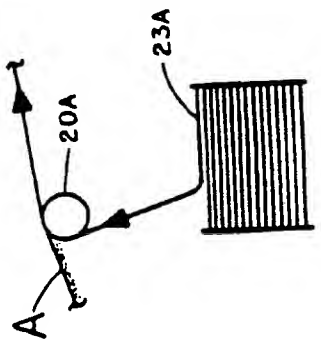

FIG. 2

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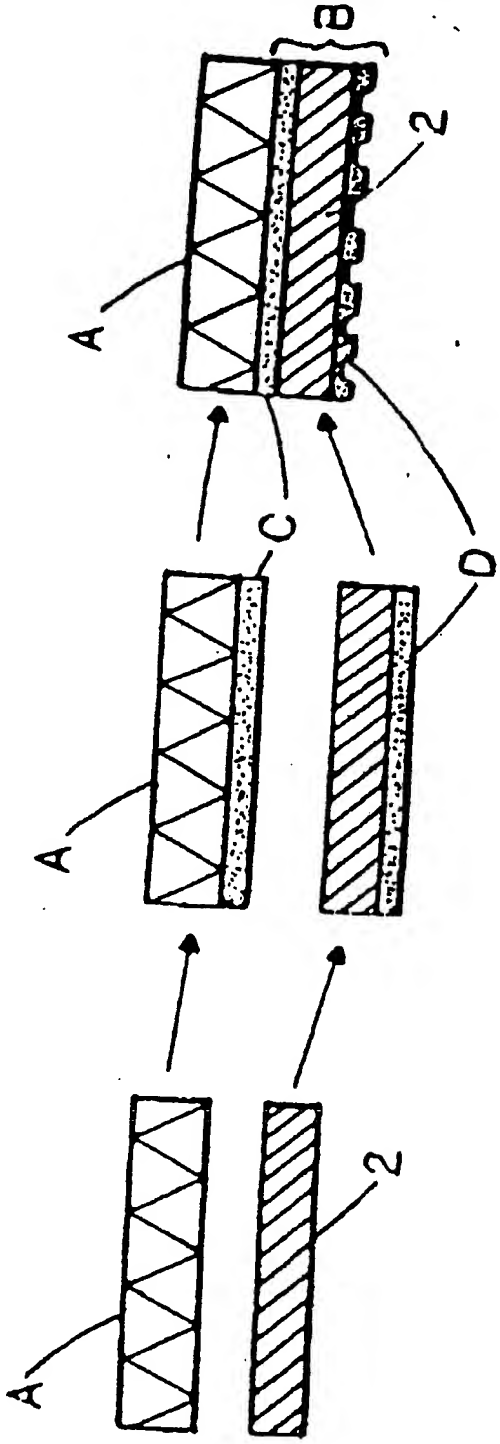

FIG.3

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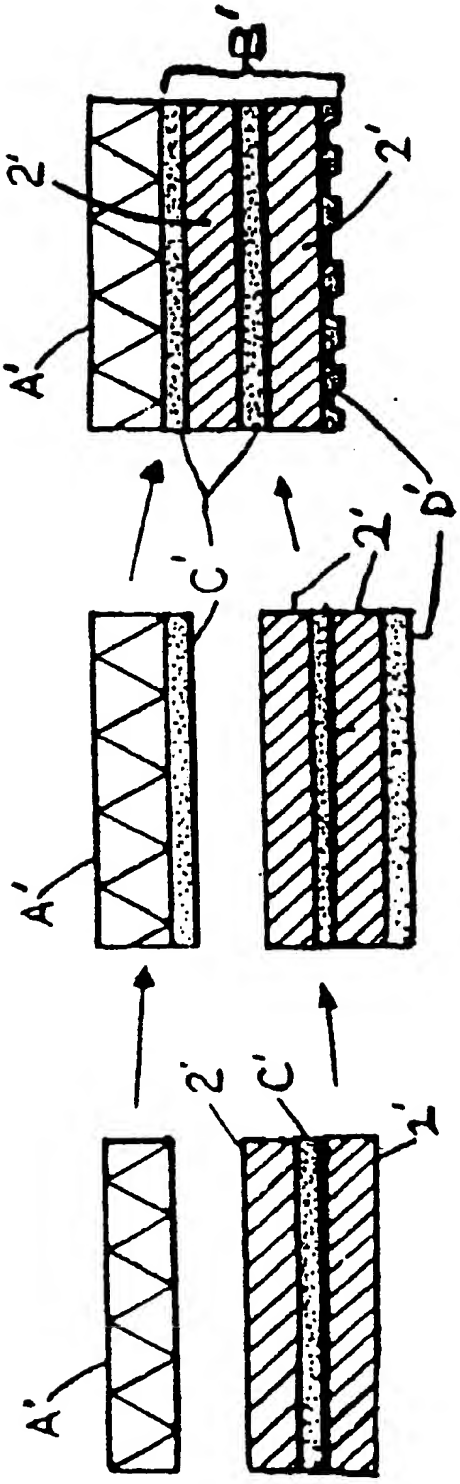

FIG. 4

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